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New Mayan Hieroglyphics Support For A Mathematical Theory of Civilizations

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ABSTRACT

Newly found Mayan hieroglyphics (at Dos Pilas, Guatemala) that describe a series of wars between Mayan "superpowers" Tikal and Calakmul appear to support a new mathematical theory of civilizations. Major events in the history of Teotihuacan (near Mexico City) in Mayan times also are consistent with the predictions of this theory.

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Introduction

Recently new Mayan hieroglyphics were accidentally found in Dos Pilas, Guatemala that describe a series of events and wars between the Mayan "superpowers" Tikal and Calakmul [1]. These historical findings appear to support a new mathematical theory of civilizations [2]. Previously Mayan history was viewed as a collection of random wars between city-states that ended around 900 AD in a mass exodus from the cities. It now appears that Mayan civilization was undergoing a pattern of development that is similar to the pattern of development of Eurasian civilizations. The pattern of Eurasian civilizations is described in Reference 2.

Summary of the Theory of Civilizations

There have been numerous attempts to develop a theory of history that would make some sense of the seemingly random events of history. Toynbee [3] and others [4] have examined 6,000 years of history and concluded that the course of history should be viewed in terms of civilizations. Civilizations appear to have a common structure of growth and decline that Toynbee characterized as a "three and a half beat pattern." This roughly 1,000 year pattern consists of a growth phase that ends in a breakdown (usually a major conflict). The breakdown begins a disintegration phase with peaks and valleys ("rallies" and "routs") following a regular pattern with 400 years spent in a time of troubles phase followed by 400 years in a universal state. The rallies of a civilization progressively decrease in amplitude as it disintegrates.

Based on the work of Toynbee and others, we [2] have developed a mathematical theory of civilizations that appears to match historical events in detail for all civilizations. The theory is formulated within a Newtonian dynamical framework. Its approach is similar in spirit to that of Lewis F. Richardson's theory of arms races and wars [5].

We assume that a civilization can be described by two variables: its societal level S and the change in its societal level C. The definition of the societal level of a civilization is necessarily imprecise. We will define the societal level S to be the "health" or strength of a civilization in terms of its political and social institutions, social cohesion, ability to solve problems, capacity for technological innovation, flexibility in finding solutions, and enterprise in meeting challenges. The societal level is also a measure of the inner development and inner state of mind (the psyche) of the people of a civilization. It can

also be viewed as a measure of the "sentiment" of the civilization's members about the future. In a sense Rome fell because the sentiment of the Roman Empire turned negative – people had very negative expectations about the future. The phrase "cosmic senescence" summarized that view – the universe, and Rome, was winding down. As Rome expected to fail it did and the barbarians easily overcame a dispirited populace. The societal level can be viewed as a civilization's equivalent to "consumer sentiment" in economics. Consumer sentiment indicates the consumer's view of the future and thus the consumer's likelihood to spend. Societal level indicates the populace's view of the future and the health of its civilization.

The variable C is the time rate of change of the societal level:

$$C = dS/dt \tag{1}$$

As a result the societal level is:

$$S = \int_0^t dt'\, C(t') \tag{2}$$

When we discuss civilizations we often speak of the forces affecting a civilization: internal forces (primarily social), and external forces (barbarians, environment, and so on). These forces "move" a civilization in one direction or another. With this thought in mind we have constructed a preliminary theory of civilizations using Newton's law:

$$F = mA \tag{3}$$

where F is the total force on a civilization, m is its "mass", and A is its "acceleration" (which is related to its societal growth). We assume the acceleration $A = C''$, the second time derivative of C.

For most of Mankind's existence societies have been static with $S = C = 0$. Civilizations are dynamic societies that first appeared about 6,000 years ago. They grow and change, and have been observed to have a 3.5 beat pattern of disintegration. It is reasonable to assume that this pattern is inherent in civilizations and not the result of external forces.

Toynbee suggests this point when he refers to the 'Laws of Nature'. So we separate the force on a civilization into an internal force F_{int} and an external force F_{ext}, and assume that a 3.5 beat pattern is generated by internal forces.

$$F = F_{int} + F_{ext} \tag{4}$$

When we consider change in society we notice that there is often resistance to change. Resistance takes two forms: a resistance to the increasing rate of change, and a resistance to the total change. We express these socio-psychological concepts as forces:

$$F_{int} = F_0 = -rC' - sC \tag{5}$$

(F_0 is introduced for later use.) In the absence of external forces Newton's law (eqn. (3)) becomes the equation of a damped harmonic oscillator:

$$mC'' + rC' + sC = 0 \tag{6}$$

The solution can be taken to be

$$C = c_1 e^{-at} \sin(bt) \tag{7}$$

with the societal level:

$$S(t, r) = c_1[b - e^{-at}(a \sin(bt) + b \cos(bt))]/(a^2 + b^2) \tag{8}$$

where a, b, c_1, and c_2 are constants, t is the time since the civilization's beginning, and

$$a = r/(2m) \tag{9}$$

$$b = \sqrt{s/m - r^2/(4m^2)} \tag{10}$$

Both C and S are zero at the beginning of the civilization. S approaches a constant value representing the cumulative effects of the civilization as t gets large:

$$S(t, r) \rightarrow c_1 b/(a^2 + b^2) \tag{11}$$

Although a civilization may disintegrate, parts of its social structure and culture generally survive.

The constants a and b have been determined by earlier studies [2] of Eurasian civilizations to have the values a = 0.00281 and b = .0235. Since we are unable to experimentally measure the absolute value of S we set c_1 equal to 1. The relative values of S during the history of a civilization can be compared to historical events and thus provide *copious "experimental" tests of the theory*.

We will call the S curve with these parameter values the *Standard S curve*. The equation for the Standard S curve is approximately:

$$S(t) = [1 - e^{-.00281t}(.12\sin(.0235t) + \cos(.0235t))]/.0235 \qquad (12)$$

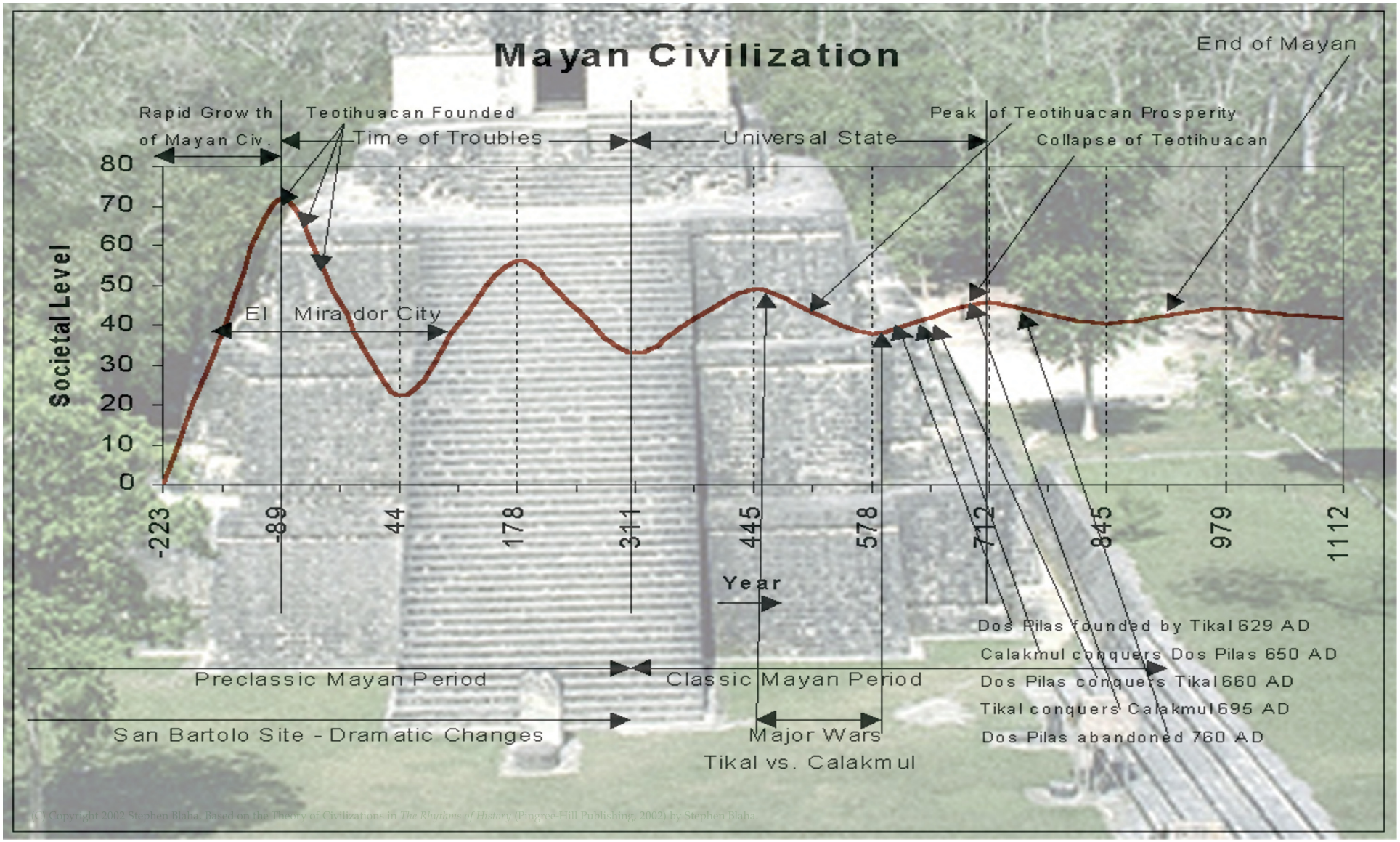
with time measured in years.

Theory Compared to Mayan History

We have compared the standard solution (eqn. (12)) of the theory (and the extended theory) with various civilizations and found a close match with the history of all known Eurasian civilizations [2]. If we now apply the Standard S Curve to Mayan civilization we need to set only one parameter – the point where the civilization began its rise. In Reference [2] we set the beginning of Mayan civilization to 223 BC with the result:

$$S_{Mayan}(t) = S(t + 223) \qquad (13)$$

where $S_{Mayan}(t)$ is the curve for Mayan civilization. (t = -223 or t = 223 BC is the beginning year of the civilization; prior to that year we view the Mayan society as largely static.) BC years are specified as negative numbers. The Figure shows the plot of $S_{Mayan}(t)$ as a red line. Some events of Mayan history (including the new hieroglyphic data) are identified in the Figure and show good agreement with the ups and downs of $S_{Mayan}(t)$.



Comments on Mayan Civilization

A series of major wars between Tikal and Calakmul, Mayan superpowers, in the fifth through seventh centuries appears to have brought Mayan civilization to its knees. Recently unearthed hieroglyphics [1] describe phases of this war such as the founding of an important military outpost (stronghold) Dos Pilas by Tikal in 629, its conquest by Calakmul around 650, its emergence as a powerful state that conquered its founder Tikal around 660, and its eventual abandonment in 760. Thus a sequence of what originally appeared to be local conflicts between 600 and 700 were, in reality, a continuation of a "world war" between Tikal and Calakmul that culminated in the conquest of Calakmul in 695 by Tikal.

The roughly 250 years of warfare between Tikal and Calakmul lasting from the fifth through seventh centuries corresponds to the 267 year cycle found in Western civilization and Middle Eastern and Asian civilizations found by Blaha [2], and Arnold Toynbee [3] and others [4], in studies of 6,000 years of human civilizations.

Mayan civilization began with a roughly 134 year period of major growth starting around 223 BC. Great cities were built such as El Mirador. Teotihuacan was also founded in the first century BC. Mayan civilization then went through three and a half cycles of ups and downs just like Eurasian civilizations. The last cycle was dominated by constant wars between Tikal and Calakmul that culminated in the decline of Mayan civilization. Tikal's conquest of Calakmul around 700 AD started the last stage of decline that ended in the complete abandonment of the Mayan cities around 900 AD. The last stages of the decline of the Mayans can be compared to the last stages of the decline of Rome: constant warfare with Barbarian invaders culminating in the conquest of Rome and the reduction of Rome to a small agricultural village among splendid ruins.

Thus the spectacle afforded by Mayan history compares with that of European and Asian civilizations, and confirms the evolution of civilizations is based on our common human nature.

The Figure shows a chart of the ups and downs of the history of Mayan civilization from its beginning around 223 BC until its end around 900 AD according to the Theory of Civilizations. The red line is a plot of the "societal level" – the inherent strength (health)

of the overall civilization. The graph is superimposed on a photograph of an impressive Mayan Temple.

As can be seen in the period from 445 – 575 AD, overwhelming fratricidal warfare between states weakened the strength of the civilization. The period between 580 and 700 shows an upturn in the civilization that is probably due to a lower level of conflict that allowed the civilization to begin growing again. The settlement at Dos Pilas in 629 and its growth into a major power support the notion that the Seventh Century was a period of growth.

The emergence of a "winner" – Tikal – in 695 with the conquest and destruction of Calakmul roughly marks the high point of the period as shown in the Figure.

The period denoted "Time of Troubles" [2] was probably a period of fierce conflict between the city-states. In Eurasian civilizations it is normally a period of ruinous conflict.

The period denoted "Universal State" in the Figure normally [2] is a time in the life of a civilization where the civilization is dominated by an empire. In the case of Mayan civilization this time may actually have been a time dominated by a confederation of states that often had internal wars. It may have been analogous to the Parthian Empire, which consisted of loosely united, more or less independent provinces.

Teotihuacan appears to follow the pattern of Mayan civilization. Based on trade and other data it appears Teotihuacan was part of the greater Mayan civilization. Note that it was founded during the period of great initial growth, reached its peak shortly after a peak in Mayan civilization and collapsed at roughly the same time as Calakmul was conquered.

Conclusion

It appears that new data on Mayan history supports the mathematical Theory of Civilizations as applied to Mayan civilization.

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